



ECONOMY AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA

The Use of Benefit Transfer in the Evaluation of Water Quality Improvement: An Application in China

Du Yaping

EEPSEA RESEARCH REPORT SERIES

EEPSEA is supported by a consortium of donors and administered by IDRC.
Mailing address: Tanglin PO Box 101, Singapore 912404.
Visiting address: 7th Storey RELC Building, 30 Orange Grove Road.
Tel: 65 235 1344 Fax: 65 235 1849
Internet: dglover@idrc.org.sg or hermi@laguna.net
Website: <http://www.idrc.org.sg/eepsea>

**ARC HIV
113556**

Comments should be sent to the author: Du Yaping, Editorial Office, World Economy, Chinese Academy of Social Sciences, 5 Jiannei Dajie, Beijing 100732.
Email: duyaping@yahoo.com

The Economy and Environment Program for South East Asia (EEPSEA) was established in May 1993 to support research and training in environmental and resource economics. Its objective is to enhance local capacity to undertake the economic analysis of environmental problems and policies. It uses a networking approach, involving courses, meetings, technical support, access to literature and opportunities for comparative research. Member countries are Thailand, Malaysia, Indonesia, the Philippines, Vietnam, Cambodia, Laos, China, PNG and Sri Lanka.

EEPSEA's funding is provided by a consortium of donors. As of June 1998, these sponsors consisted of IDRC (Canada), Sida (Sweden), Danida (Denmark), CIDA (Canada), the Ministries of Foreign Affairs of Norway and the Netherlands and the MacArthur Foundation (USA).

EEPSEA Research Reports are the outputs of research projects supported by EEPSEA. They have been peer reviewed and edited. In some cases, longer versions are available from the authors. EEPSEA also issues a Special Papers Series, consisting of commissioned papers emphasizing research methodology.

EEPSEA is supported by a consortium of donors and administered by IDRC.

Mailing address: Tanglin PO Box 101, Singapore 912404 • Visiting address: 7th Storey RELC Building, 30 Orange Grove Road • Tel: 65 235 1344 • Fax: 65 235 1849 • Internet: dglover@idrc.org.sg or hermi@laguna.net • Website: <http://www.idrc.org.sg/eeepsea>



**ECONOMY AND ENVIRONMENT PROGRAM
FOR SOUTHEAST ASIA**

**The Use of Benefit Transfer in the Evaluation of Water
Quality Improvement: An Application in China**

Du Yaping

March 1999

ARCHIV
628.19(510)(285)

D 8

TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 BENEFIT TRANSFER METHOD	2
3.0 SCREENING OF LITERATURE	3
3.1 The Policy Site	3
3.2 Literature Search	3
3.3 Three Primary Study Cases	4
4.0 ADJUSTMENT	5
4.1 Per Capita GDP Adjustment for Transnational Transfer	5
4.2 Price Index Adjustment for Time Factor	5
5.0 RESULTS FROM AN ORIGINAL STUDY IN THE POLICY SITE	6
6.0 COMPARISONS BETWEEN THE BENEFIT TRANSFER ESTIMATE AND THE "ACTUAL" VALUE	7
7.0 CONCLUSIONS	8
REFERENCES	10

LIST OF TABLES

Table 1. Benefit transfer calculations (unit: \$ or CNY per capita per annum).	6
Table 2. Statistical values of variables.	7
Table 3. Comparison of the secondary estimates with the primary study results (unit: CNY/capita/annum).	8
Table 4. Total benefit from the C&M case as compared with the "actual" case.	8

THE USE OF BENEFIT TRANSFER IN THE EVALUATION OF WATER QUALITY IMPROVEMENT: AN APPLICATION IN CHINA

Du Yaping

Institute of Economics, Hubei Academy of Social Sciences*

1.0 INTRODUCTION

Since the late 1960s, economists have been developing methodologies to measure environmental impacts. Among the approaches most widely used are the travel cost method (TCM) and the contingent valuation method (CVM). Generally, these methods provide a reasonable approximation of the value of a non-marketed environmental good or service; their drawbacks are that they are time-consuming and expensive.

The pressures of time and budget are common during project appraisals. Traditional cost-benefit analyses (CBA) are now supplemented by environmental impact assessments (EIA) with results that are often difficult to reconcile. While the CBA is expressed in monetary value, the EIA is usually in physical terms. To compare the two, the EIA must be converted to a monetary value; but time and money for a full-scale valuation are rarely available. The use of 'benefit transfer' (BT) is often advocated (ADB, 1996). This involves taking the results from one or more primary economic studies with estimated values for similar impacts, and modifying and transferring them to the project being evaluated. In cases where a high degree of precision is not critical, BT may provide useful information for decision-making. Frequently, it will be the only way of providing such information.

The inclusion of environmental impacts in project appraisals has increased greatly in the last 10 years. Interest in benefit transfer has grown correspondingly and literature on the subject is now substantial (e.g., Desvougues, et al. 1992; Navrud, 1996). But efforts to test the approach in developing countries are relatively few. Since most original valuation studies have been done in developing countries, efforts to validate the transfer of values between developed and developing countries, and between developing countries, are especially needed.

This study uses the benefit transfer method to value water quality improvements to a recreational lake in Wuhan, China. Particularly novel is the comparison of results transferred from the US and the Philippines to the author's original study of the lake (Du, 1998). After a brief review of methodological aspects in Section 1, relevant literature is screened and suitable cases were selected for the transfer exercise. In Section 3, the values from three primary studies were adjusted and transferred to the policy site to derive the environmental benefits from water quality improvement in East Lake, Wuhan. These benefit transfer values were further compared with results from the author's primary study (Du, 1998) to examine the validity of BT and its scope for wider application in China. Conclusions and discussion are provided in the last section.

* Current Address: Editorial Office, World Economy, Chinese Academy of Social Sciences, 5 Jiannei Dajie, Beijing 100732.

2.0 BENEFIT TRANSFER METHOD

The idea of benefit transfer emerged in the early 1980s when the US Environmental Protection Agency (USEPA) proposed the use of desk studies as the basis for cost-benefit analysis in environmental impact assessment because of capital and time constraints. This approach puts forward the notion that the cost and benefit associated with the supply of an environmental good or service in question could be derived from findings in existing reports. However, derivation from available original studies may involve biases from the estimates of the benefits. In a simple model (Greene, 1997), the process could be described as

$$\text{minimize} \quad \text{MSE}(\hat{e}) = \text{Var}(\hat{e}) + (\text{Bias}(\hat{e}))^2$$

$$\text{subject to} \quad \text{AF} = \text{AF}_0; \text{AT} = \text{AT}_0$$

where: \hat{e} : benefit estimate
MSE : mean variation
Var : sample variation
AF : means available capital resources
AT : available time
AF₀ and AT₀: constraints as specified in Desvougues, et al. (1992).

Clearly this is an optimization problem with given constraints. The objective is to minimize the mean variation with available resources. Policy makers have three choices: (1) give up the objective function or declare the non-existence of feasible solutions; (2) relax the constraints so that a primary study can be undertaken; and (3) search for transferable materials and adjust them as necessary for a benefit transfer study. The first alternative is not acceptable as it implies that cost-benefit analysis would not be undertaken. Decision-making without such analysis might result in social costs much larger than the cost of a primary study. In fact, government regulation stipulates that environmental benefits be valued as part of the environmental impact assessment. The second choice does not seem realistic either. In many cases, an original study in the US would need US\$50,000 and 4 to 8 months of time (McConnell, 1992); many studies cost much more. In addition, it is not economical to repeat similar surveys. The last choice appears reasonable as it could obtain useful information without too much time and money, particularly for projects that do not require a high degree of accuracy. This raises the need for application of secondary valuation methods such as a benefit transfer study.

In practical benefit transfer studies, the value to be transferred can be either benefit or cost. It can also be a functional transfer or a single unit value transfer. If suitable functional relations and parameters are available, then a functional transfer can be more useful to reveal the dose-response relationship and provide valuable information on the impact of a change on one variable. However, as the functions obtained from travel cost method (TCM) and contingent valuation method (CVM) often have low coefficients, the transfer of such functions can lead to further uncertainties. In this case, the transfer of unit value can be more manageable as it can be adjusted as necessary. In this exercise, unit values rather than functions were transferred.

For a benefit transfer study, it is essential to start with initial environmental examination (IEE) or environmental impact assessment (EIA) so that the scope of the analysis can be properly defined. The second step is to select the literature. With the impacts quantified in IEE/EIA, the selection of primary study materials must look for those with environmental impacts similar in magnitude and type; similar socioeconomic characteristics; and high quality up-to date information. The site of the previous research is usually called the "study site" while the site to which the benefit estimate is transferred is called the "policy site" (Navrud, 1996). Because differences between the study site and the policy site are inevitable, values must be adjusted to reflect site-specific features. After the adjustment, unit values for the policy site can be calculated and discounted totals can be derived. This analysis focused on unit values since total values were unnecessary for the comparison.

3.0 SCREENING OF LITERATURE

3.1 The Policy Site

East Lake (Donghu) is a recreational site well known for its vast water surface area (33 km²), natural tranquility, and beauty within the metropolitan boundary of Wuhan. Each year, millions of visitors come to the lake to enjoy recreational activities, most of which are directly related to water such as boating, swimming, and angling. Recently water pollution has seriously impaired recreational quality, especially for swimming. Three sites with swimming facilities have been closed as they are located in the most polluted part of the lake. As a result, people have to travel farther to find cleaner water, in areas that are less safe and less enjoyable because they lacked facilities. If water quality was a marketable good, its value would be easily determined and realized in the market. Since it is not, there is a need to estimate the value of water quality for recreation, which can be used as evidence by policymakers and the managers of the lake to see if clean up efforts are worthwhile. This provided the motivation for the author's 1997 study.

In selecting other studies for purposes of BT, the author concentrated on those that valued water quality improvement for recreational purposes. The literature was screened to find those study areas with similar features to the project case. Ideally, the socioeconomic situations in the study site should be as close as possible to the policy site. In reality, such similarities are very limited. In some cases, no information on some features is given in the literature. Therefore, in the screening process, socioeconomic features were used at the second stage.

3.2 Literature Search

As few Chinese cases were reported in the literature, the search was concentrated on English literature published in journals in the last 20 years. There were more than a dozen cases related to water quality improvement. All the studies resulted in estimates of the values associated with water quality improvement. Some of them had derived estimate functions but were not applicable to the policy site, since the study sites and the policy sites were different. Others did not use comparable measures. In the end, there were only three comparable studies; two in the US and one in the Philippines.

3.3 Three Primary Study Cases

The first case is *The Economic Benefits of Surface Water Quality Improvement in Developing Countries: A Case Study of Davao, Philippines* by Choe, Whittington, and Lauria (hereafter referred as C, W & L), published in *Land Economics* in 1996. In this study, a survey was undertaken on willingness to pay for water quality improvement but no differentiation was made with regard to various quality levels. In the policy site, there are different water quality levels suitable for different types of recreational uses. However, the advantage of this case was that it was done in a developing country, which made it more relevant to China.

The study area had a population of 600,000 (in 100,000 households). Per capita income averaged \$34 per month and the average adult had 10 years of education. Among the 1,200 respondents, 36 refused to answer the questionnaire, while 777 replies (65%) were useful. The 'useful' respondents were divided into three groups in accordance with housing and water supplies. Both TCM and CVM were employed. Correspondents were further divided into two groups: users and non-users. Results showed that the estimates obtained from the two methods were very close. When water quality was improved from boatable to swimmable, CVM value was US\$3.41, US\$2.16 and US\$2.56 per capita per annum for users, non-users, and combined user-nonuser groups, respectively (excluding the refusals to pay). The TCM result gave a value of US\$2.88 per capita per annum, which was very close to the CVM figure.

The second case is the paper by Carson and Mitchell (1993), published in *Water Resources Research*. The study used the CVM approach and evaluated the willingness to pay (WTP) for increased water quality for all the rivers in the US. The authors used the national average income, price level, and population as indicators for this study. The findings suggest that WTP per capita per annum was US\$139 for water quality improvement from unusable to boatable; US\$206 for further improvement to swimmable. The incremental value of improvement from boatable to fishable was US\$38 and from fishable to swimmable, US\$28.

The third case is the primary study by Desvousges, Smith, and Fisher (hereafter referred as D,S&F), published in 1987, which estimated the option value for increased water quality in Monogahela River. Sample of the population was from nearby residents by the river aged 18 and above. Among the 393 questionnaires sent out, 301 (77%) were returned. Household heads had an average of 10-12 years of schooling, and average household size was four. Both payment cards and repeated bidding methods were used in the survey. The study, had four subsets of surveys with two starting points, iterative bidding, and two direct questionings for users and nonusers. In comparison with the Philippine case, WTP figures from user and non-user groups in the four sets of surveys were rather mixed. Therefore, the unit value from this case used the mean figure from the four sets of surveys. The results showed that the WTP value for water quality improvement from unusable to boatable was US\$10.00 per annum per household. The incremental value for quality improvement from boatable to fishable was US\$6.13, and US\$3.22 for improvement from fishable to swimmable. From boatable to swimmable, the WTP value was US\$9.78.

The above three cases were closest to the policy site with respect to environmental impacts and socioeconomic features. All involved value of water quality improvement for recreational uses, although none dealt with lake water quality within an urban boundary. Both users and nonusers of environmental services related to river water quality improvement were included in the valuation exercises. CVM was the primary valuation method in all three.

4.0 ADJUSTMENT

The unit values from these three cases are summarized in the first column of Table 1. Ideally, before comparing them, adjustment should be made to offset such influences as differences of income, price level, preferences, culture, substitution, social characteristics, climate, living style, and resource base. Hence, the transferred value would be more realistic. However, such comprehensive adjustment is not feasible; it is impossible to eliminate all biases or errors. In the following analysis, two adjustments were made: for per capita GDP and price level.

4.1 Per Capita GDP Adjustment for Transnational Transfer

WTP for environmental goods is the monetary measure of the goods and services given up by the consumer for environmental improvement. This means that WTP value is a function of purchasing power. Therefore for transnational transfer, it is necessary to take into account the purchasing power and monetary unit between the country of the original study and that of the policy site. In the ADB Workbook (1996) for environmental evaluation, a simple approach of per capita GDP is suggested. Such an approach implies that people always spend the same proportion of their disposable income on environmental impacts. The underlying implication is that environmental services are neither necessities nor luxury goods, since the poor spend more of their income on necessities than the rich. Despite this somewhat unrealistic assumption, it is still an appropriate approach since income is the most important factor affecting an individual's willingness to pay.

4.2 Price Index Adjustment for Time Factor

Normally there is a time difference between the primary study and the transfer exercise. Often when one searches for primary cases with similar features, one has to review the literature for studies done years before. It is very likely that the level of development could have changed drastically during the period. In addition to income levels, consumption preferences and the environment may also undergo significant changes. Therefore, it is also necessary to remove the time influence as much as possible. However, the only measurable indicator is the price index, which often reflects the rate of inflation. So after the GDP adjustment, price index is used to take into account the impact of time difference. Other potential factors are added to the error item.

The above two adjustments are presented in Table 1. The figures from the three original cases are given in column 1. Figures in columns 2 and 3 are per capita GDP in the countries of original study and the policy site, respectively. Figures in column 4 are the estimates for the project after GDP adjustment, while those in column 6 are

final estimates after further time adjustment. The time adjustment was made with reference to the survey time rather than the publication time as there is a time lag between survey and publication. All the figures are in per capita terms per annum given the quality improvement for recreational water. The results varied greatly, with some figures very close and others far apart. The reasons for the large variation are analyzed in a subsequent section.

Table 1. Benefit transfer calculations (unit: \$ or CNY per capita per annum).

	WTP ₀ (1) \$	GDP _t (2) \$	GDP _d (3)	WTP ₁ (4)=(1) × (3)/(2)	P _t / P ₀ (5)	WTP _p (6)=(4)×(5)
C,W&L B S	2.56	963.9	3,755.20	9.97	1.00	9.97
M&C						
U—B	139.00	15,291.5	669.55	6.09	2.64	16.08
U—S	206.00			9.02		23.81
B—F	38.00			1.66		4.38
F—S	28.00			1.23		3.25
D,S&F						
U—B	10.00	12,639.1	479.32	0.38	2.80	1.06
B—F	6.13			0.23		0.64
F—S	3.22			0.12		0.34
B—S	9.78			0.37		1.04

Sources: World Economy Yearbook, 1982, 1987, 1988, 1990,1995; China Economic Yearbook, various years.

Notes:

1. WTP₀ - WTP figures in the original study; GDP_t - Per capita GDP in the country of original study; GDP_d - Per capita GDP in current year of investigation; WTP₁ - WTP after first adjustment; P_t/P₀ - the ratio of price index in the policy site (Wuhan, China); WTP_p - the estimated value after the benefit transfer calculation.
2. Water quality levels: U - unusable; B - boatable; F - fishable; S - swimmable.

5.0 RESULTS FROM AN ORIGINAL STUDY IN THE POLICY SITE

In 1996, a primary study was undertaken on the valuation of improved water quality for the recreational East Lake using both CVM and TCM (Du, 1998). The results (given below) were used as the "actual" value of the water quality improvement to test the benefit transfer figures.

A total of 600 copies of a questionnaire were distributed by interviewers in the survey. Of these 501 were returned and 408 were found usable for TCM and CVM analyses. Survey results showed that over 50 percent of the sample were occasional visitors; 16.7 percent visited only once a year and perhaps once in a lifetime for visitors from outside Hubei Province. The main purposes of multiple visits were walking, jogging, swimming, and boating, which were either highly localized or seasonal activities. As to visitors' judgment on water quality, less than 5 percent of the visitors considered it good, in contrast to nearly 60 percent who believed it was bad or very bad; a third considered it tolerable or replied "don't know." Most visitors were from relatively high income families, with an average of CNY 407 per capita per month (1995 prices; 8.28 CNY = US\$1). They had usually 13 years of schooling

which was higher than the national average; over half obtained higher education. The age structure suggests that over 90 percent of the visitors were of working age.

Table 2. Statistical values of variables.

Variable		Mean	Std Dev	Median	Minimum	Maximum
No. of visits						
E-level	existing quality	21.78	49.34	4.0	1.00	301.00
B-level	suitable for boating	23.84	52.75	5.0	1.00	320.00
S-level	suitable for swimming	26.91	54.89	7.0	1.00	330.00
D-level	suitable for drinking	31.14	60.49	9.5	1.00	350.00
Distance	km	89.30	176.35	9.0	1.50	600.00
Self judgement on WQ	on a 1-5 scale (1: polluted; 5: clean)	2.28	0.83	2.0	1.00	5.00
Income	(Y/c/m)	407.34	123.20	450	130.00	570.00
Education	schooling years	13.01	3.84	16.0	0	19.00
Age (ys)	years	37.95	11.59	37.0	18.00	67.00
Sex	m=1; f=0	0.73	0.45	1.0	0	1.00
WTP-D	Y/a/c	27.46	32.24	20.0	0	200.00
WTP-S	Y/a/c	18.14	24.41	10.0	0	250.00
WTP-B	Y/a/c	10.26	13.88	5.0	0	100.00
WTP: y/n	y=1; n=0	0.81	0.40	1.0	0	1.00

Note: water quality levels: D = drinkable; S = swimmable; B = boatable/fishable;
 E = existing level; WQ = water quality; y/c/m = yuan per capita per calendar month;
 ys = years; y/a/c = yuan per annum per capita.

6.0 COMPARISONS BETWEEN THE BENEFIT TRANSFER ESTIMATE AND THE "ACTUAL" VALUE

If the results estimated from the author's CVM study are assumed to be the "real" value of the water quality improvement, the findings can be compared with the benefit transfer figures to see if the benefit transfer is valid or not.

The figures from the three transfer cases and the original study are given in Table 3. The first case was the closest one, being one-fourth higher than the "actual" value. The Carson and Mitchell case showed some similarities to the first one. The second estimates departed from the "actual" values for unusable to boatable and swimmable, ranging from less than 10 percent to 1/3. For the increment from boatable to swimmable, the secondary figure was surprisingly close to that from the primary study, having only a seven percent difference. However, the secondary estimate from the third case was significantly lower than the "actual" value.

If the unit value is acceptable for the benefit transfer analysis, the aggregate figures may be further examined (Table 4). The figures suggest that the benefits of water quality improvement are significant enough to warrant undertaking a primary study of costs and benefits of cleaning up. In 1997, the provincial government started a World Bank loan project on East Lake Water Quality Control which had a total investment of US\$106 million. An earlier benefit transfer study might have contributed to a more timely decision-making.

Table 3. Comparison of the secondary estimates with the primary study results (unit: CNY/capita/annum).

	WTPBT(1)	WTPCVM(2)	WTP(3=1-2)	rate of var. (4=3/1)
C,W&L B S	9.97	7.88	2.09	+21.0%
M&C U—B	16.08	10.26	5.82	+36.2%
U—S	23.81	18.14	5.67	+23.8%
B S	7.73	7.88	-0.55	-7.1%
D,S&F U—B	1.06	10.26	9.2	-867.9%
U—S	2.04	18.14	16.1	-789.2%

Table 4. Total benefit from the C&M case as compared with the "actual" case.

Quality	Average		Present Value (aggregate, million)			
	y/a/c		d=8%		d=3%	
	"actual"	BT value	"actual"	BT value	"actual"	BT value
Existing-boatable	10.26	16.08	347.76	545.03	884.43	1,386.12
Boatable-swimmable	7.88	7.73	267.17	262.08	679.46	666.53
Existing-swimmable	18.14	23.81	614.93	807.14	1,563.88	2,082.17

7.0 CONCLUSIONS

The benefit transfer method has been advocated as a quick and low-cost approach to valuation of environmental goods despite its likely inaccuracies and uncertainties. The analysis using a CVM study of the economic benefits from improved water quality for recreation in Wuhan, China as the "real" value to test the validity of the transfer results, revealed a couple of interesting points.

First, benefit transfer estimates and the "real" value varied from very close to over eight times. This indicated that the benefit transfer technique could lead to either meaningful or biased figures. Controlling differences over long time spans and for embedding effects seems to be particularly important.

Second, how the quality of the environmental good is specified is very important. In this case, the "good" to be offered was water quality improvement. For a meaningful derivation of benefit transfer estimate, the actual change of water quality must be specified. If the existing water quality is acceptable to the consumer, he/she may not wish to pay for further improvement. When the physical features of the "good" are included for adjustment, benefit transfer values could be more reliable.

This study has shown the potential for the application of benefit transfer, and pointed out some of the areas where particular attention is called for in the transfer and adjustment process. Further research and more empirical studies would be valuable in further developing this technique.

REFERENCES

- ADB. 1996. Economic Evaluation of Environmental Impacts. A Workbook. ADB, Manila, Philippines
- Bell, F. W. and V. K. Leeworthy. 1990. Recreational Demand by Tourists For Saltwater Beach Days. *Journal of Environmental Economics*. Vol. 18.
- Bouwes, N. W. and R. Schneider. 1979. Procedures in Estimating Benefits of Water Quality Change. *American Journal of Agricultural Economics*. Vol. 61.
- Boyle, K. J and J.C. Bergstrom. 1992. Benefit Transfer Studies: Myths, Pragmatism and Idealism. *Water Resources Research*. Vol. 28.
- Brookshire, D. S. and H. R. Neill. 1992. Benefits Transfer: Conceptual and Empirical Issues. *Water Resources Research*. Vol. 28.
- Carson, R. T. and R. C. Mitchell. 1993. The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable and Swimmable Quality Water. *Water Resources Research*. 29: 7, pp. 2445-2454.
- Choe, K., D. Whittington, and D. T. Lauria. 1996. The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines. *Land Economics*. Vol. 72.
- Desvousges, W. H., M. C. Naughton, and G. R. Parsons. 1992. Benefits Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies. *Water Resources Research*. Vol. 28.
- Desvousges, W. H., V. K. Smith, and A. Fisher. 1987. Option Price Estimates for Water Quality Improvements: A Contingent Valuation Study for the Monogahela River. *Journal of Environmental Economics*. Vol. 14.
- Downing, M. and T. O. Zuna. 1996. Testing the Reliability of the Benefits Function Transfer Approach. *Journal of Environmental Economics*. Vol. 30.
- Du Yaping. 1998. The Value of Improved Water Quality: An Application of Contingent Valuation and Travel Cost Methods to East Lake in Wuhan, China. EEPSEA Workshop.
- Editorial Board of the Yearbook of World Economy. 1982, 1984, 1990, 1995. The Yearbook of World Economy. Economic Science Press, Beijing.
- Envalue. 1996. NSW EPA Environmental Valuation Database. New South Wales, Australia.
- Feather, P. and D. Hellerstein. 1997. Calibrating Benefits Function Transfer to Assess the Conservation Reserve Program. *American Journal of Agricultural Economics*. Vol. 79.

- Freeman III, A. M. 1993. The Measurement of Environmental and Resource Values: Theory and Methods, *Resources for the Future*. Washington D.C.
- Greene, W. H. 1997. *Econometric Analysis*. 3rd ed. Prentice Hall, New Jersey.
- Improvements. 1984. Draft Report to the Office of Policy Planning, and Evaluation. *U.S. EPA, Resources for the Future*, Washington, D.C.
- Kirchhoff, S., B. G. Colby, and J. T. La France. 1997. Evaluating the Performance of Benefits Transfer: An Empirical Inquiry. *Journal of Environmental Economics*. Vol. 33.
- Loomis, J. B. 1992. The Evolution of a More Rigorous Approach to Benefits Transfer: Benefits Function Transfer. *Water Resources Research*. Vol. 28.
- McConnell, K. E. 1992. Model Building and Judgment Implications for Benefits Transfers with Travel Cost Methods. *Water Resources Research*. Vol. 28.
- Navrud, S. 1996. The Benefits Transfer Approach to Environmental Valuation. EEPSEA, Singapore.
- Provencher, B. and R. C. Bishop. 1997. An Estimable Dynamic Model of Recreation Behavior with an Application to Great Lakes Angling. *Journal of Environmental Economics*. Vol. 33.
- Smith, V. K., W. H. Desvousges, and A. Fisher. 1984. A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits. Working Paper 83—w32, Vanderbilt University, Nashville, Tennessee.
- The Development Research Center of the State Council. 1982, 1984, 1995. Almanac of China's Economy. Economic Administration Press, Beijing.
- Walsh, R. G., O. M. Johnson, and J. R. McKean. 1992. Benefits Transfer of Outdoor Recreation Demand Studies. 1968-1988. *Water Resources Research*. Vol. 28.

EEPSEA RESEARCH REPORT SERIES

**Economic Benefits of Watershed Protection
and Trade-off with Timber Production:
A Case Study in Malaysia**

*Mohd Shahwahid H.O., Awang Noor, A.G.,
Abdul Rahim N., Zulkifli Y. & Razani U.*
May 1997

**An Economic Analysis of Alternative Mangrove
Management Strategies in Koh Kong Province,
Cambodia**

Camille Bann
November 1997

**An Economic Analysis of Tropical Forest Land
Use Options, Ratanakiri Province, Cambodia**

Camille Bann
November 1997

**Pricing for Groundwater Use of Industries in
Metro Manila, Philippines**

Maria Corazon M. Ebarvia
November 1997

**Overfishing in the Philippine Marine
Fisheries Sector**

Danilo C. Israel and Cesar P. Banzon
January 1998

**Understanding Household Demand for Water:
The Metro Manila Case**

Cristina C. David and Arlene B. Inocencio
January 1998

**The Value of Improved Water Quality for
Recreation in East Lake, Wuhan, China:
Application of Contingent Valuation
and Travel Cost Methods**

Du Yaping
May 1998

**Tradable Discharge Permits System for Water
Pollution of the Upper Nanpan River, China**

Wendong Tao, Weimin Yang, & Bo Zhou
June 1998

**Economic Valuation of Mangroves and the Roles
of Local Communities in the Conservation of
Natural Resources: Case Study of Surat Thani,
South of Thailand**

Suthawan Sathirathai
June 1998

**Damage Schedules for Thai Coastal Areas:
An Alternative Approach to Assessing
Environmental Values**

Ratana Chuenpagdee
August 1998

**The Pollution Charge System in China:
An Economic Incentive?**

Yun Ping
September 1998

**Environmental Valuation: An Entrance Fee System
for National Parks in Thailand**

Adis Isangkura
September 1998

**Estimation of Environmental Damages from
Mining Pollution: The Marinduque Island Mining
Accident**

Ma. Eugenia Bennagen
November 1998

**Surrogate Pricing for Water: The Case of
Micro Hydro-electricity Cooperatives in Northern
Thailand**

Sitanon Jesdapipat and Siriporn Kiratikarnkul
December 1998

**Impact of Agro-Chemical Use on
Productivity and Health in Vietnam**

*Nguyen Huu Dung, Tran Chi Thien,
Nguyen Van Hong, Nguyen Thi Loc,
Dang Van Minh, Trinh Dinh Thau,
Huynh Thi Le Nguyen, Nguyen Tan Phong,
and Thai Thanh Son*
January 1999

**Economic and Health Consequences of Pesticide Use
in Paddy Production in the Mekong Delta, Vietnam**

Nguyen Huu Dung and Tran Thi Thanh Dung
February 1999



Economy and Environment Program for Southeast Asia